Chronic Neutrophilic Leukaemia (CNL)

A Guide for Patients

Leukaemia Care
YOUR Blood Cancer Charity

Introduction

Being diagnosed with chronic neutrophilic leukaemia (CNL) can be a shock, particularly when you may have never heard of it. If you have questions about CNL – what causes it, who it affects, how it affects your body, what symptoms to expect and likely treatments – this booklet covers the basics for you.

For more personalised information, talk to your haematologist, clinical nurse specialist or hospital pharmacist.

This booklet was written and updated by our Patient Information Writer, Isabelle Leach and reviewed by Professor Mary Frances McMullin. We are also grateful to our patient reviewer Elaine-Mary Brown for their valued contribution to the booklet.

If you would like any information on the sources used for this booklet, please email **communications@leukaemiacare.org.uk** for a list of references.

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In this booklet

About Leukaemia Care

Leukaemia Care is a national charity dedicated to ensuring that people affected by blood cancer have access to the right information, advice and support.

Our services

Helpline

Our helpline is available 8:30am – 5:00pm Monday - Friday and 7:00pm – 10:00pm on Thursdays and Fridays. If you need someone to talk to, call **08088 010 444**.

Alternatively, you can send a message via WhatsApp on **07500068065** on weekdays 9:00am – 5:00pm.

Nurse service

We have two trained nurses on hand to answer your questions and offer advice and support, whether it be through emailing **nurse@leukaemiacare.org.uk** or over the phone on **08088 010 444**.

Patient Information Booklets

We have a number of patient information booklets like this available to anyone who has been affected by a blood cancer. A full list of titles – both disease specific and general information titles – can be found on our website at **www.leukaemiacare.org.uk/support-and-information/help-and-resources/information-booklets/**

Support Groups

Our nationwide support groups are a chance to meet and talk to other people who are going through a similar experience. For more information about a support group local to your area, go to **www.leukaemiacare.org.uk/support-and-information/support-for-you/find-a-support-group/**

Buddy Support

We offer one-to-one phone support with volunteers who have had blood cancer themselves or been affected by it in some

way. You can speak to someone who knows what you are going through. For more information on how to get a buddy call **08088 010 444** or email **support@leukaemiacare.org.uk**

Online Forum

Our online forum, **www.healthunlocked.com/leukaemia-care**, is a place for people to ask questions anonymously or to join in the discussion with other people in a similar situation.

Patient and carer conferences

Our nationwide conferences provide an opportunity to ask questions and listen to patient speakers and medical professionals who can provide valuable information and support.

Website

You can access up-to-date information on our website, **www.leukaemiacare.org.uk**.

Campaigning and Advocacy

Leukaemia Care is involved in campaigning for patient well-being, NHS funding and drug and treatment availability. If you would like an update on any of the work we are currently doing or want to know how to get involved, email **advocacy@leukaemiacare.org.uk**

Patient magazine

Our magazine includes inspirational patient and carer stories as well as informative articles by medical professionals: **www.leukaemiacare.org.uk/communication-preferences/**

What is chronic neutrophilic leukaemia?

Chronic neutrophilic leukaemia (CNL) is a very rare myeloproliferative neoplasm (MPN) in which there is a persistent increase in the number of white blood cells in the bone marrow, mainly the mature neutrophil cells. MPNs are chronic disorders where the myeloid stem cells in the bone marrow make too many abnormal red blood cells, white blood cells, or platelets which do not function properly. In CNL, there are too many neutrophil cells. Neutrophil cells protect the body against bacterial infections and inflammation.

In the bone marrow, blood forming stem cells either produce more stem cells or divide to develop into one of the working blood cells such as red blood cells, white blood cells, or platelets. The production of new blood cells is very closely controlled so that it is balanced with the loss of worn-out cells or cells lost by bleeding or damage. A blood stem cell in the bone marrow may become a myeloid cell or a lymphoid cell.

A myeloid cell develops into one of three types of mature blood cells:

- Red blood cells that carry oxygen and other substances to all tissues of the body
- Platelets that form blood clots to stop bleeding
- White blood cells that fight infection and disease

A lymphoid cell becomes one of three types of lymphocyte white blood cells:

- B-lymphocytes (B-cells) that make antibodies to help fight infection
- T-lymphocytes (T-cells) that help the B-cells make the antibodies to fight infection
- Natural killer cells (NK-cells) that attack cancer cells and viruses

White blood cells can be either granulocytes, so-called because they have granules in their cells, and include neutrophils, eosinophils and basophils, or agranulocytes, which do not have granules in their cells, and include lymphocytes or monocytes.

While neutrophils protect the body against bacterial infections and inflammation, eosinophils protect against parasites and

allergens and basophils create the inflammatory reactions during an immune response.

The role of lymphocytes is to recognise bacteria, viruses and toxins, to which they produce antibodies. These antibodies then attack and destroy the invading bacteria, virus or parasite. Monocytes remove the infection products from the immune system.

Neutrophils are the most common white blood cells accounting for 40% to 80% of all white blood cells, and the normal count for neutrophils in peripheral blood is 5-10x10^9/litre of blood. Therefore, patients with CNL may also have an increase in their total white blood cell count of greater than 25x10^9/l (normal range: 4 to 11x10^9/l).

While the most common causes for an increase in number of neutrophils are infection and inflammation, it may also be the result of some cancers.

Who is affected by CNL?

To date, only around 200 patients with CNL have been identified. The median age at diagnosis of the patients with CNL in one large study was 73 years, and it is slightly more common in males (60%).

What causes CNL?

The exact cause of CNL is still unknown. It cannot, however, be caught from someone or passed onto your children. Known risk factors that increase the chances of getting CNL include:

- Being over 50 years of age
- Being male
- Having certain gene mutations, particularly the CSF3R T618I mutation

The origins of the CNL leukaemia cells have been linked with the myeloid stem cells in the bone marrow. It is thought that the excessive reproduction of the mature neutrophils associated with CNL is linked to genetic abnormalities.

More than 80% of patients with CNL are found to have a high number of mutations in the gene which controls the receptor for colony stimulating factor 3 (CSF3R) in white blood cells. The role of CSF3R is to promote the maturation of white blood cells,

What is chronic neutrophilic leukaemia? (cont.)

which include neutrophils. In patients with CNL, this mutation, known as T618I, activates the CSF3R to cause an increased production of mature neutrophils that is the hallmark of CNL.

The CSF3R T618I mutation, discovered in 2013, is now part of the required criteria for the diagnosis CNL according to World Health Organisation (WHO) classification of myeloid neoplasms and acute leukaemia. In addition to the high prevalence of CSF3R mutations in CNL, other mutations have also been identified in the genes of patients with CNL such as the following:

- SETBP1 (SET binding protein 1) in 14-56% of patients
- SRSF2 (Serine and arginine Rich Splicing Factor 2) in 21% of patients
- TET2 (Ten-Eleven Translocation-2) in 30% of patients
- ASXL1 (Additional Sex combs-like 1) in 30-60% of patients

The large ranges in the number of patients harbouring these mutations is due to the relatively small numbers of patients (between 4 and 20 patients) included in each of the CNL genetic studies, given the rarity of CNL.

If you would like more information about acute myeloid leukaemia (AML) you can download a copy of our booklet from our website at **www.leukaemiacare.org.uk** or request a copy by emailing **support@leukaemiacare.org.uk** or calling the helpline on **08088 010 444**.

What are the signs and symptoms of CNL?

Patients with CNL do not normally present with specific symptoms apart from possible fatigue or easy bruising. Often a routine blood test or medical examination will show an abnormal blood cell count or enlarged liver and/or spleen.

In due course, the excess of neutrophils circulating in the blood will cause signs and symptoms such as:

- Fatigue
- Weight loss
- Easy bruising
- Bone pain
- Night sweats
- Enlarged spleen which causes a feeling of fullness below the ribs on the left side
- Enlarged liver

How is CNL diagnosed?

Blood and bone marrow samples are examined to diagnose CNL according to the 2016 WHO classification criteria. The following diagnostic tests are required:

- Blood sample: Blood samples are obtained to measure the complete blood cell count (number and quality of white blood cells, red blood cells and platelets), as well as the types of white blood cells to show which white blood cells are increased.
- Bone marrow biopsy – A small sample of bone marrow is needed to confirm the diagnosis. The bone marrow sample can be taken from the hip bone under local anaesthetic, using special biopsy needles: liquid bone marrow (aspirate) and/or a tiny core of bone marrow tissue (trephine).
- Chromosome analysis to detect common gene mutations linked to CNL such as CSF3R T618I mutations.

CNL diagnostic requirements

The cells from the blood and bone marrow are examined under a microscope by a haematologist (doctor who specialises in diseases of the blood). To make the diagnosis, the 2016 WHO classification criteria for CNL must be fulfilled. These are:

Peripheral blood white blood cells greater or equal to 25 $x10^9/l$.

- Segments of, or immature, neutrophils making up 80% or greater of white blood cells
- Immature neutrophils making up less than 10% of white blood cells
- Immature neutrophil myeloid stem cells rarely observed
- Monocyte count less than $1x10^9/l$
- No abnormality in the development of granulocytes in general

Presence of the CSF3R T618I mutation or other activating CSF3R mutations.

Hypercellular (many cells

present) bone marrow, where the amount of bone marrow cells are increased relative to the amount of bone marrow fat.

- Increased number and percentage of neutrophils
- Maturation of neutrophils appears normal
- Myeloid stem cells make up less than 5% of bone marrow cells which have a nucleus

The following diagnoses must be excluded:

- Chronic myeloid leukaemia: Positive for the BCR-ABL1 (Breakpoint Cluster Region-Abelson Murine Leukaemia Viral proto-oncogene 1) gene
- Polycythaemia vera (abnormal increase of red blood cells)
- Essential thrombocythaemia (excess production of platelets leading to abnormal blood clotting)
- Primary myelofibrosis (build-up of scar tissue in the bone marrow)

No rearrangement (exchange of genetic material among genes) for the following genes:

- PDGFRA and PDGFRB (Platelet-Derived Growth Factors Receptors A and B) genes
- FGFR1 (Fibroblast Growth Factor Receptor 1) gene
- PCM1-JAK2 (PeriCentriolar Material 1-Janus-Activated Kinase 2) gene

OR

In the absence of a CSFR3R mutation, patient must have:

- Persistent increase in the number of neutrophils for at least three months
- Enlargement of the spleen
- No identifiable cause for an increase in the number of neutrophils, including absence of a plasma cell cancer
- Or, if present, demonstration of genetically identical myeloid cells

The CSF3R T618I mutation represents an accurate and specific marker for the diagnosis of CNL.

What is the treatment for CNL?

Overview of treatment

There is currently no standard of care for CNL. Since the discovery of the CSF3R T618I gene, which established CNL as a distinct clinical leukaemia type, the treatments for the other chronic leukaemias are no longer used in CNL patients. However, given that CNL is very rare, CNL-specific treatments are limited.

Current treatment for CNL is based on managing the symptoms, using cytoreductive drugs, which decrease the number of cells in the blood, such as hydroxycarbamide (also known as hydroxyurea) and interferon-alpha (IFN-a).

Some chemotherapy drugs such as thalidomide, cladribine, imatinib and ruxolitinib have also been used but with little success.

New drugs in development:

- Since CSF3R gene mutations are present in the majority of patients with CNL, research has concentrated on these mutations for possible new treatments.
- Two types of CSF3R mutations which showed susceptibilities to different drugs in the laboratory have been demonstrated. These mutations are the CSF3R T618I mutation and the truncated CSF3R mutations, which show susceptibilities to ruxolitinib and dasatinib, respectively.
- However, case reports of ruxolitinib in CNL patients have shown mixed results, and the efficacy and safety of dasatinib in patients with CNL are still being studied.

Hydroxycarbamide

Hydroxycarbamide was previously the most used treatment in patients with CNL as it reduces the white blood cell count and decreases the enlarged spleen, which is caused by the greatly increased numbers of white blood cells.

After initial efficacy with hydroxycarbamide, most CNL patients tend to become refractory (i.e. stopped responding to their treatment).

Interferon alpha

IFN-a is a known immunotherapy,

which boosts the body's natural immune system to fight the leukaemia. Specifically, it reduces the rate at which blood cells are made in the bone marrow

IFN-a is the only treatment which has been shown to give durable remission in CNL patients. A review of 14 cases of patients with CNL featured a patient who achieved clinical remission for 41 months while being treated with IFN-a. However, in another case report, one patient with CNL achieved only partial response for at least two years when receiving IFN-a in combination with hydroxycarbamide, but then suffered progression of the CNL.

Targeted chemotherapy

Chemotherapy is the use of drugs that prevent the ability of cancer cells to grow and divide, thereby destroying the cancer cells over time. Targeted therapy is a treatment that targets specific genes or proteins of leukaemia cells.

In the search for new targeted chemotherapies for the treatment of CNL, efforts have concentrated on the CSF3R mutations:

- CSF3R T618I mutation, situated close to the membrane of the cell, activates the JAK enzyme protein and is therefore susceptible to the JAK inhibitor, ruxolitinib.
- Truncated CSF3R mutations, where the gene is shortened or truncated, are situated in the middle of the cell and activate SRC kinases. These mutations exhibit drug sensitivity to SRC kinase inhibitors, such as dasatinib.

The first JAK inhibitor, ruxolitinib was approved in 2012 for the treatment of patients with polycythaemia vera, and myelofibrosis which is a serious cancer characterised by bone marrow fibrosis. However, treatment with ruxolitinib in CNL patients has produced mixed results.

Ruxolitinib

Several patients have shown a positive response with ruxolitinib:

- One patient who had the CSF3R T618I mutation receiving ruxolitinib 10mg twice daily showed a significant decrease

What is the treatment for CNL? (cont.)

in the number of neutrophils and white blood cells, as well as normal platelet levels. When the dose was increased to 15mg twice daily, the patient showed further improvement after 11 months of treatment.

- In a CNL patient with a CSF3R T618I/G739 mutation, treatment with ruxolitinib for 11 months decreased the white blood cell count from 50% to 8%. This was maintained for a further nine months, before the patient relapsed.

Conversely, less convincing responses have also been experienced with ruxolitinib in patients with CNL. Three case reports of patients with CNL associated with CSF3R and SETBP1 mutations have shown variable outcomes with ruxolitinib treatment.

- In one case report, a patient with both CSF3R T618I and SETBP1 mutations, did not show any meaningful improvement with hydroxycarbamide, so oral ruxolitinib 10mg daily was added to the patient's treatment. The patient stopped responding to both treatments, and the white blood cell count increased when the drug doses were increased to ruxolitinib 20mg twice daily and hydroxycarbamide 1g daily.
- In two patients who both had CSF3R T618I and SETBP1 G870S mutations, oral ruxolitinib 20mg daily only showed a response of five and nine months.

Despite CSF3R mutations being present in a large number of patients with CNL, there are other mutations, such as the SETBP1 or ASXL1 mutations, which are thought to be interacting with the CSF3R mutations to explain these different results.

To further clarify the role of ruxolitinib in CNL patients with varying mutations, a multicentre phase 2 clinical trial (NCT02092324; **clinicaltrials.gov/ct2/show/study/NCT02092324**) is currently in progress to determine the proportion of patients with CNL and aCML who respond to ruxolitinib. The study started on 5 May 2014 and was due to be completed in 24 January 2020. No results have been published to date.

Other chemotherapy

The use of standard leukaemia induction therapy with an anthracycline drug and cytarabine for the accelerated or blast phases of CNL has failed to achieve lasting remission.

Stem cell transplant

While it theoretically represents the only chance of a cure, few case reports of allogeneic stem cell transplantation (allo-SCT) in patients with CNL are available.

Nevertheless, because of the possibility of the evolution of CNL into acute myeloid leukaemia (AML) and the number of cases of CNL that become refractory, allo-SCT can be used for certain patients. An allo-SCT is the receipt of blood forming stem cells from a genetically similar, but not identical, donor.

- A series of case reports of nine patients aged from 15 to 60 years, who received an allo-SCT from sibling donors or matched unrelated donors, were successful for six patients (66.7%) with periods of ongoing remission varying from one to 78 months.
- All but one of these patients received myeloablative conditioning, which involves giving the patient chemotherapy or irradiation just before the transplant to eradicate the patient's cancerous cells before infusing the donor with blood forming stem cells, and also to suppress immune reactions.
- Of the three patients whose allo-SCT was not successful, two of the patients received transplants following blast transformation in the accelerated phase. Both died shortly after the transplant due to toxicity and/or relapse.

Other case reports have confirmed that patients receiving allo-SCT in the blast or accelerated phases appear to experience worse outcomes with regards to toxicity and/or early relapse.

Despite no firm evidence being available, it appears that allo-SCT is best performed in the chronic phase of CNL. Therefore, it may be prudent to have patients evaluated for allo-SCT early in their disease and certainly before the blast transformation stage.

What is the treatment for CNL? (cont.)

Surgical removal of the spleen

Surgical removal of the spleen may be recommended for some patients to relieve symptoms of abdominal pain. A surgical oncologist who is a doctor specialising in cancer surgery will usually perform this procedure. Removal of the spleen, however, caused an increase in neutrophils and is only really used as a palliative measure. Splenic irradiation (use of high energy radiation from X-rays, gamma rays, or neutrons to kill cancer cells and shrink tumours) can be used to decrease abdominal pain caused by the enlarged spleen

Clinical trials

When making treatment plan decisions, patients are often encouraged to consider clinical trials as an option to give them access to new treatments being investigated. Your physician can guide you in this decision. Any clinical trials that are recruiting can be found at: **https://clinicaltrials.gov/**

Follow-up

Follow-up after treatment is an important part of your cancer care. Follow-up for CNL is often shared among your haematologist and your family doctor. Your healthcare team will work with you to decide on your follow-on care.

What is the prognosis of CNL?

CNL may stay the same for many years or it may progress quickly to AML. Risk factors which will indicate a patient's outcome are evaluated by the haematologists. Your haematologist is the best person to advise you on your prognosis, based on your individual circumstances.

Given that only 200 cases of CNL have been reported to date, prognosis estimates, in terms of survival and transformation rates to AML, must be viewed with caution in view of the small number of patients studied.

Median survival for CNL based on calculations from a number of CNL case reports was between 21 to 30 months. However, some people may survive much longer after diagnosis, with case reports of CNL patients surviving for six

months to more than 20 years, with a five year survival of 28%.

A recent series of 22 case reports of patients with CNL, all of whom had the CSF3R T618I gene mutation, showed a median overall survival of 24 months, which is similar to previous reports above.

Factors which indicate your CNL is progressing include resistance to treatment, persistently increased neutrophil levels, dependency on blood transfusions, and worsening of the enlargement of your spleen and liver.

Transformation of CNL to AML is reported to occur in 10% to 21% of patients. The median time to an AML transformation is 21 months with a range of three to 94 months.

Prognostic markers

The presence of a protein marker or gene mutation can help estimate the prognosis in patients with CNL:

- The presence of an ASXL1 mutation is associated with a poor prognosis as it is in other leukaemia of myeloid cell origin.
- Mutations in SRSF2 gene in patients with CNL indicate a poor prognosis.
- The presence of a SETBP1 mutation is linked with an average prognosis.
- The CSF3R T618I mutation and other CSF3R mutations in patients with CNL do not seem to have a bearing on the prognosis.

Living with CNL

After a diagnosis of CNL, you may find that it affects you both physically and emotionally. This chapter will talk about both of these aspects.

Emotional impact of CNL

Being told you have cancer can be very upsetting. Some of the symptoms of CNL can be hard to cope with and, because of this, you may need emotional, as well as practical, support. Being diagnosed with a rare disease can affect the whole of you, not just your body, and it can impact you emotionally at any point of your journey. It is likely that you will experience a range of complex thoughts and emotions, some of which may feel strange or unfamiliar. It is important to know that these feelings are all valid and a normal response to your illness.

"There was a total overwhelming feeling of helplessness and being out of control of my normal everyday life. But I had to carry on regardless for everyone else."

Looking after you

Following a diagnosis of CNL, you may want to make changes to your lifestyle to try to stay as well as possible, after your diagnosis and during treatment. Do not try to change too much at once. Adopting a healthy way of living is about making small, manageable changes to your lifestyle.

A healthy lifestyle includes having a well-balanced diet and being physically active. With some of your side effects, the idea of getting out and being active may be the last thing you want to do, but it is important to try and stay as active as possible to make you feel better and reduce some of your symptoms or side effects.

One of the most commonly reported side effects of the treatment of CNL is fatigue. This is not normal tiredness and does not improve with sleep.

Some general tips on how to deal with fatigue include:

- Have a regular lifestyle – try going to bed and waking up at approximately the same time every day and try to avoid lying in.

- Take part in regular, gentle exercise to maintain your fitness levels as much as possible.
- Reserve your energy for what you find important and build rest periods around those times.
- Before going to bed, avoid stimulants such as alcohol, coffee, tea or chocolate, or using laptops, tablets or mobile phones.
- Keep your bedroom quiet and at a comfortable temperature.
- Talk about your worries with family, friends, your doctor or nurse, or in-patient support groups.
- Discuss your fatigue with your doctor or nurse.

"Don't get me wrong, it's hard living with a chronic condition. I get tired a lot and have to be careful about picking up infections, as my immune system is lower than others. But all in all, I will not let it take over my life. I don't intend on fighting it; it will have to fight me."

You can find more information about living well with leukaemia at **www.leukaemiacare.org.uk/support-and-information/information-about-bloodcancer/living-well-withleukaemia/**. Alternatively, if you're struggling to come to terms with your diagnosis and prognosis, you can speak to us on our helpline. Call us on **08088 010 444**.

Talking about CNL

Talking to your haematologist

CNL is a rare condition. It is important for you to develop a good working relationship with your haematologist, so you are given the best treatment possible for you.

The following gives advice on working well with your haematologist:

- If it is an initial consultation, take along a list of your current medications and doses, and a list of any allergies you may have
- If you have a complicated medical history, take a list of diagnoses, previous procedures and/or complications
- Make a list of questions to take to your appointment. This will help the discussion with your haematologist
- It can be useful to repeat back what you have heard so that you can be sure that you fully understood
- Note information down to help you remember what was said
- Be open when you discuss your symptoms and how you are coping. Good patient doctor communication tends to improve outcomes for patients

Other tips:

- Bring someone else along to your appointment – they can provide support, ask questions and take notes if required
- Do not be afraid to ask for a second opinion – most haematologists are happy for you to ask

You need to tell your haematologist if...

You're having any medical treatment or taking any products such as prescribed medicines, over the counter treatments or vitamins. It is important to understand that treatments, including complementary therapies, which are perfectly safe for most people, may not be safe if you are being treated for CNL.

Remember, if you choose to start any form of complementary therapy outside of your medical treatment, discuss this with your haematology consultant or

clinical nurse specialist, prior to beginning it. It is important to understand the difference between complementary therapies, used alongside standard treatment, and alternative therapies, used instead of standard treatment. There is no evidence that any form of alternative therapy can treat CNL.

Talking to other people

Telling people you have a rare condition like CNL can be hard to explain. You might find it useful to let your close family and friends, as well as your employer know about your health condition. It might be easier to provide people with basic information and give them information leaflets about CNL if they want to know more in-depth details.

"I made a conscious decision to be very open about my illness. Telling family was tough. But I encouraged people to ask questions."

It is probably best to focus conversations on the symptoms that you are experiencing, how the condition affects you and how you feel about it. Often people misunderstand and, unfortunately, it will mostly fall to you to educate them as best as you can. Where possible, it is advisable to let people know what you find helpful and unhelpful, in terms of what others say and do. Often people make assumptions and do what they think helps. For example, saying you look well, recounting stories of others they know with a similar diagnosis, encouraging you to look ahead and stay positive is not always what people really want to hear. In many ways, the more you communicate with them the better.

These points may help you:

- Explain that you have a condition that means your bone marrow does not function properly, and that this affects the number of blood cells it produces
- Explain your symptoms (maybe you are tired, or have a lot of pain)
- Explain what you need (maybe more help day-to-day, or someone to talk to)

You could also consider the

Talking about CNL (cont.)

following when telling people about your diagnosis:

- **Find out more** - Try to find out as much as you can about your condition from reliable internet sources, charitable organisations or your consultant haematologist. The more you know, the more you can share.
- **Have a print-out to hand** - It may help to have some information to hand to share with family and friends. This will take the pressure off you having to remember everything they may want to know.
- **Explain your needs** - Try and be clear about what your needs may be. Perhaps you need help with the weekly food shop, help with cooking dinner, or someone to drive you to and from appointments. You may find that friends and family are pleased that they can do something to help you.
- **Be open about how you feel** - Do not be afraid of opening up about how you feel, as people who care will want to help you as best they can. Talk as and when you feel comfortable, so those around you will know when you need them most.

If you're struggling to come to terms with your diagnosis and prognosis, you can speak to us on our helpline. Call us on **08088 010 444**.

Glossary

Acute Leukaemia

Leukaemia which progresses rapidly and is generally aggressive. There are two types: acute lymphoblastic leukaemia and acute myeloid leukaemia.

Acute Lymphoblastic Leukaemia (ALL)

Leukaemia in which lymphocytes start multiplying uncontrollably in the bone marrow, resulting in high numbers of abnormal, immature lymphocytes. Lymphocytes are a type of white blood cell involved in the immune response.

Acute Myeloid Leukaemia (AML)

Rapid and aggressive cancer of the myeloid cells in the bone marrow.

Allogeneic stem cell transplant (allo-SCT)

Transplant of stem cells from a matching donor.

Amino acids

Organic molecules which are the building blocks for making proteins.

Anaemia

Condition where the number of red blood cells are reduced. Red blood cells contain haemoglobin and transport oxygen to body cells. This may be due to a lack of iron, leukaemia, or sickle cell disease.

Anthracycline

Antibiotic derived from the bacteria Streptomyces peucetius which was found to be an effective anticancer drug.

Antibody

Large Y-shaped protein produced by B-cell lymphocytes in response to a specific antigen, such as a bacteria, virus, or a foreign substance in the blood. The antibodies neutralise the bacteria and viruses.

Antigen

Toxin or other foreign substance which induces an immune response in the body, especially the production of antibodies.

Blast Cells (Blasts)

Immature cells found in the bone marrow which are not

Glossary (cont.)

fully developed. Up to 5% of the cells found in the bone marrow are blast cells. Patients with leukaemia have a much higher number of immature, abnormal cells called blasts cells.

Blood Cancer

Cancer of blood cells from the bone marrow or lymphatic system. There are three main types of blood cancer:

- Leukaemia begins in the bone marrow and is classified according to the type of blood cell it affects (either myeloid or lymphoid) and whether it grows quickly (acute) or slowly (chronic).
- Lymphoma starts in the lymphocyte white blood cells within the lymphatic system.
- Myeloma is a cancer of the plasma cells and starts in the bone marrow. Plasma cells are a type of white blood cell that makes antibodies.

Blood Cells

Cells present in the blood and bone marrow which include red blood cells, white blood cells and platelets. These three types of blood cell make up 45% of the blood volume, with the remaining 55% being plasma, the liquid component of blood.

Bone Marrow

Soft blood-forming tissue that fills the cavities of bones and contains fat, immature and mature blood cells, including white blood cells, red blood cells and platelets.

Bone Marrow Aspirate

Bone marrow aspirates consist of taking a sample of the liquid part of the soft tissue bone marrow inside your bones using a syringe. They are crucial to establish a diagnosis of leukaemia and may be performed at stages during treatment to monitor progress.

Bone Marrow Biopsy

Bone marrow biopsy involves the collection of a sample of bone marrow from the hip bone, generally under local anaesthesia. A bone marrow surgical instrument with a cylindrical blade, called trephine, is used to remove a 1 or 2 cm core of bone marrow in one piece.

Chemotherapy

Drugs that work in different ways to stop the growth of cancer cells, either by killing the cells or by stopping them from dividing.

Chromosomes

Thread-like structures which carry the genes and are located in the nuclei of every cell in the body. There are 46 chromosomes (23 pairs) in humans.

Chronic Leukaemia

Leukaemia which progresses slowly and is less aggressive than acute leukaemia. There are two types: chronic lymphocytic leukaemia and chronic myeloid leukaemia.

Chronic Lymphocytic Leukaemia (CLL)

Leukaemia in which the B-lymphocytes (B-cells) in the bone marrow start multiplying excessively leading to large numbers of small, mature lymphocyte cells, which are unable to fight infection, and their presence prevents the bone marrow from producing healthy blood cells of all types.

Chronic Myeloid Leukaemia (CML)

Leukaemia in which the myeloid cells start multiplying in the bone marrow leading to large numbers of abnormal, immature myeloid cells called blasts, which prevent the bone marrow from producing enough healthy blood cells of all types.

Clinical Trial

Trial designed and planned to determine a specific answer or aim; for example, whether treatment A is better than treatment B. The study will be conducted in patients who meet particular inclusion criteria, and the results are collected and analysed to provide an answer.

ClinicalTrials.gov

ClinicalTrials.gov is a database of trials and includes details of approximately 276,190 research studies in 205 countries.

Cytarabine

Antimetabolite drug which works by disrupting the DNA of cancer cells, thereby slowing or stopping their growth.

Glossary (cont.)

Cytoplasm

Jelly-like fluid in a cell that houses all the constituents it requires for survival and reproduction.

DNA (Deoxyribonucleic Acid)

Thread-like chain of amino acids found in the nucleus of each cell in the body which carries genetic instructions used in the growth, development and functioning of the individual's cells.

Eosinophil

Type of white blood cell which has a protective immunity role against parasites and allergens.

Essential Thrombocythaemia (ET)

Increased production in the bone marrow of the platelets by the megakaryocytes, which are the platelet-forming cells. The condition leads to abnormal blood clotting or bleeding.

Fatigue

Tiredness and weakness rendering the patient unable to work or perform usual activities.

Genes

Genes are made up of DNA which stores the genetic information required to make human proteins.

Colony-Stimulating Factor (CSF)

Growth factor required to stimulate the growth of living cells.

Granulocytes

Group of white blood cells, which have granular bodies in their cytoplasm. They include the neutrophils, eosinophils and basophils white blood cells, all of which protect the body from bacteria, allergens and inflammation.

Haematology

Branch of medicine which studies the cause, prognosis, treatment, and prevention of diseases related to blood.

Haematopoiesis

Process by which blood cells are formed.

Haemoglobin

Red protein contained within the

red blood cells and responsible for transporting oxygen to the tissues of the body.

Hypomethylating Agents

Drug that inhibits the DNA methyltransferase enzyme, which prevents DNA from producing the proteins required for the normal development of CNL cells.

Immunotherapy

Treatment that uses the body's own immune system to fight the cancer.

Induction Treatment

First treatment after diagnosis intended to kill the majority of the leukaemia cells and stimulate remission.

Interferons

Naturally occurring body proteins that send signals to interfere with the ability of viruses to multiply.

Leukaemia

A group of cancers that usually begin in the bone marrow and result in high numbers of abnormal blood cells. These cells are not fully developed and are called blasts or leukaemia cells. Depending on the type of blood cell involved, there are different types of leukaemia with varying characteristics, such as acute (develop quickly) or chronic (develop slowly).

Lymphocytes

Lymphocytes are a type of white blood cell that are vitally important to the immune response. There are three types of lymphocytes: B-cells, T-cells and natural killer (NK)-cells. B-cells produce antibodies that seek out invading organisms. T-cells destroy the organisms that have been labelled by the B-cells, as well as internal cells that have become cancerous. NK-cells attack cancer cells and viruses.

Lymphoid

Relates to lymphocyte white blood cells.

Macrophage

Type of white blood cell that submerges and digests cellular debris, foreign substances, microbes, cancer cells, and anything else that does not have

Glossary (cont.)

the type of proteins specific to healthy body cells on its surface.

Monocyte

White blood cell that attacks invading organisms and helps combat infections.

Mutation (Gene)

Permanent alteration in the DNA sequence of a gene, so that it differs from what is found in most people.

Myeloblasts or Myeloid Blasts

Name given to blast cells in the myeloid cell line. These cells originate in the bone marrow and eventually become the following white blood cells: neutrophils, monocytes, macrophages, basophils, and eosinophils. Myeloid cells also give to the red blood cells and platelets.

Myelofibrosis (Primary or Secondary)

Reactive and reversible process which occurs with many cancerous and non-cancerous diseases of the bone marrow.

Myeloid

Relates to bone marrow.

Myeloproliferative Neoplasm

Disease of the bone marrow in which excess cells are produced.

Neoplasm

Medical term for cancer, meaning literally a new and abnormal growth of tissue anywhere in the body.

Nucleoli (cell)

Small dense spherical structure in the nucleus of a cell.

Palliative Care

Also known as supportive care, this is a type of care that focusses on improving the quality of life for a patient with a life-threatening illness and their loved ones.

Plasma Cell

Type of white blood cell that produces antibodies and is derived from B-cells. It is an ovoid (egg-shaped) cell with an off-centre nucleus.

Platelets

One of the types of blood cells

which help to stop bleeding.

Polycythaemia Vera (PV)

Chronic increased production of red blood cells, white blood cells and platelets in the bone marrow. When the increased production is only of the red blood cells, the condition is erythrocytosis.

Prognosis

Indication of how well a patient is expected to respond to treatment based on their individual characteristics at the time of diagnosis or other timepoint in the disease.

Radiation

Release of energy in the form of particles or waves.

Radiation Treatment

Cancer treatment that uses high doses of radiation to kill cancer cells and shrink tumours.

Red Blood Cells

Small blood cells that contain haemoglobin and carry oxygen and other substances to all tissues of the body.

Refractory

A condition for which treatment does not result in a remission. However, the condition may be stable.

Relapse

A relapse occurs when a patient initially responds to treatment, but after six months or more, the response stops. This is also sometimes called a recurrence.

Spleen

Largest organ of the lymphatic system whose function is to help clear the body of toxins, waste and other unwanted materials. The spleen is located under the ribs on the left of the abdomen.

Stem Cell

Most basic cell in the body that has the ability to develop into any of the body's specialised cell types, from muscle cells to brain cells. However, what makes these stem cells reproduce uncontrollably, as in cancer, is thought to be linked to chromosome abnormalities.

Glossary (cont.)

Stem Cell Transplant

Transplant of stem cells derived from part of the same individual or a donor.

Targeted Therapy

Drugs that specifically interrupt the leukaemia cells from growing in the body. However, these drugs do not also harm the body's healthy cells the way conventional drugs do.

White Blood Cells

White blood cells are one of the types of cells found in the blood and bone marrow, along with red blood cells and platelets. White blood cells create an immune response against both infectious disease and foreign invaders. Granulocyte white blood cells include the neutrophils (protect against bacterial infections and inflammation), eosinophils (protect against parasites and allergens) and basophils (create the inflammatory reactions during an immune response). Other white blood cells include the lymphocytes (recognise bacteria, viruses and toxins, to which they produce antibodies) and monocytes (clear infection products from the body).

Useful contacts and further support

There are a number of helpful sources to support you during your diagnosis, treatment and beyond, including:

- Your haematologist and healthcare team
- Your family and friends
- Your psychologist (ask your haematologist or CNS for a referral)
- Reliable online sources, such as Leukaemia Care
- Charitable organisations

There are a number of organisations, including ourselves, who provide expert advice and information.

Leukaemia Care

We are a charity dedicated to supporting anyone affected by the diagnosis of any blood cancer. We provide emotional support through a range of support services including a helpline, patient and carer conferences, support group, informative website, one-to-one buddy service and high-quality patient information. We also have a nurse on our help line for any medical queries relating to your diagnosis.

Helpline: **08088 010 444**
www.leukaemiacare.org.uk
support@leukaemiacare.org.uk

Blood Cancer UK

Blood Cancer UK is the leading charity into the research of blood cancers. They offer support to patients, their family and friends through patient services.

0808 2080 888
www.bloodcancer.org.uk

Cancer Research UK

Cancer Research UK is a leading charity dedicated to cancer research.

0808 800 4040
www.cancerresearchuk.org

Macmillan

Macmillan provides free practical, medical and financial support for people facing cancer.

0808 808 0000
www.macmillan.org.uk

Maggie's Centres

Maggie's offers free practical, emotional and social support to people with cancer and their families and friends.

0300 123 1801
www.maggiescentres.org

Citizens Advice Bureau (CAB)

Offers advice on benefits and financial assistance.

08444 111 444
www.adviceguide.org.uk

Leukaemia Care is a national charity dedicated to providing information, advice and support to anyone affected by a blood cancer.

Around 34,000 new cases of blood cancer are diagnosed in the UK each year. We are here to support you, whether you're a patient, carer or family member.

Want to talk?

Helpline: **08088 010 444**
(free from landlines and all major mobile networks)

Office Line: **01905 755977**

www.leukaemiacare.org.uk

support@leukaemiacare.org.uk

Leukaemia Care,
One Birch Court,
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Leukaemia Care is registered as a charity in England and Wales (no.1183890) and Scotland (no. SC049802).
Company number: 11911752 (England and Wales).
Registered office address: One Birch Court, Blackpole East, Worcester, WR3 8SG

Leukaemia Care
YOUR Blood Cancer Charity